SANDIA LABNEWS
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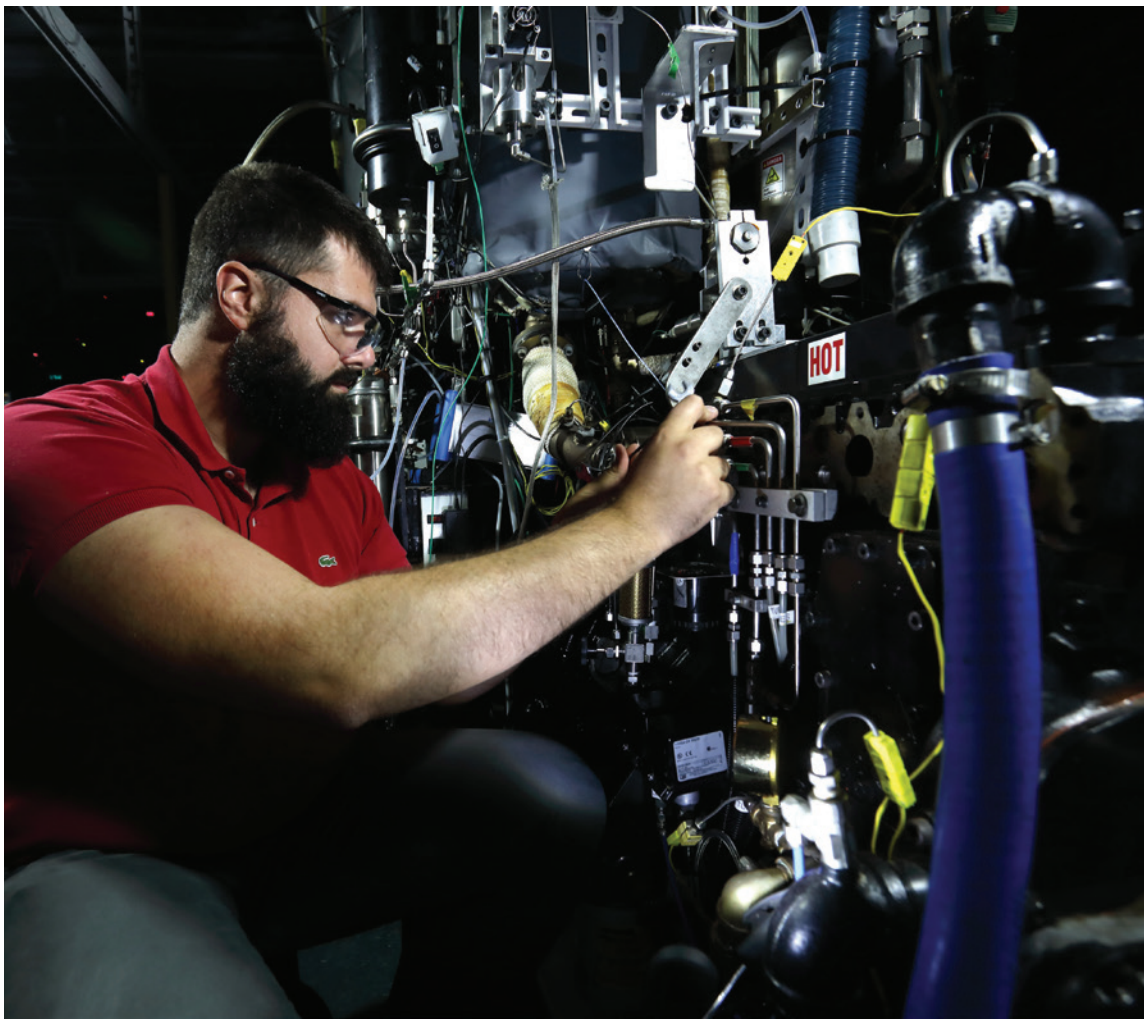
Fuel property put to the test at Sandia's CRF

Sandia postdoc receives SAE Excellence in Oral Presentation Award for phi-sensitivity research



PHI-SENSITIVITY — Dario Lopez Pintor makes a key adjustment on the Sandia low-temperature gasoline combustion research engine. **Photo by Dino Vournas**

By ***Michael Padilla***

Understanding the fundamentals of phi-sensitivity, a key fuel property that represents how the autoignition reactivity of the fuel varies with the fuel/air equivalence ratio, will help increase the efficiency and facilitate the development of practical low-temperature gasoline combustion engines, according to research conducted at Sandia's Combustion Research Facility.

Led by Sandia postdoctoral appointee Dario Lopez Pintor, the research highlights how low-temperature gasoline combustion can lead to substantial efficiency improvements to reduce fuel consumption by 30% compared to conventional gasoline engines, and the importance of phi-sensitivity for making this type of combustion work well.

Dario was recognized for his work at the 2019 SAE World Congress. He received an SAE Excellence in Oral Presentation Award for his paper, "Phi-Sensitivity for LTGC Engines: Understanding the Fundamentals and Tailoring Fuel Blends to Maximize This Property."

The work was funded by Co-Optima, an R&D collaboration between DOE, nine national laboratories, several universities and industry organizations.

The work was conducted in conjunction with John Dec, Senior Scientist and principal investigator of the low-temperature gasoline combustion laboratory in Sandia's Combustion Research

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R&D 100

Sandia researchers honored with numerous awards in annual competition

By ***Neal Singer***

The venerable R&D 100 contest, slightly more than 50 years old, has a new owner, and the competition continues. R&D Magazine is gone, a victim of changing markets, but R&D World Magazine has emerged to take its place. Once again, a collection of technical judges has been set in motion. And competing in an international pool of universities, corporations and government labs, Sandia inventions captured four R&D 100 Awards this year, as well as two environmental and one business award.

Choosing from among its applicants, the contest selects research projects that represent the year's 100 most outstanding advances in applied technologies. The awards focus on practical impact rather than pure research, and recognize entrants for their products' designs, development, testing and production.

The sole past criterion for winning has been "demonstrable technological significance compared with competing products and technologies." Apparently, these criteria are unchanged. Judges in this year's contest noted properties such as smaller size, faster speed, greater efficiency and higher environmental consciousness.

The R&D 100 Awards began in 1963. Since 1976, Sandia has earned 127 awards, including this year's winners.

R&D 100 awards

ADDSec: Artificial Diversity and Defense Security, principal investigator Adrian Chavez

Industrial control-system environments, such as the electric power grid, oil and natural gas refineries and water pipelines, continue to use predictable communication paths, static configurations and unpatched software, all of which benefit adversaries.

Sandia has developed a technology that automatically detects and responds to threats within critical infrastructure environments in real time. The detection approach uses a set of machine learning algorithms that recognizes anomalous behavior and then classifies those anomalies into categories of attacks. The response approach uses software-defined networking to randomize IP addresses and application port numbers, invalidating the attacker's knowledge of the network and preventing successful deployment of attacks.

CHIRP: Cloud Hypervisor-forensics and Incident Response Platform, principal investigator Vincent Urias

CHIRP gives cyber analysts a holistic view of Cloud systems, providing the tools required to collect forensic artifacts, evidence and incident response materials in real time without disturbing the user environment or alerting the intruder. Using CHIRP, analysts can pinpoint suspicious activities, track and record attacker actions for forensic analysis and retrieve materials transparently from the targeted machines automatically or on-demand. The features of CHIRP also may be used by responders to disrupt malicious copying, deleting, obfuscating, encrypting and relocating of data in a Cloud environment.

MIRaGE: Multiscale Inverse Rapid Group-theory for Engineered-metamaterials, principal investigator Ihab El Kady

Experimental approaches (perhaps intuitive ones) good luck and considerable calculation could eventually lead a designer to a metamaterial with suitable properties for particular tasks, but this search can be a tedious, hit-or-miss process.

Artificial Diversity and Defense Security principal investigator Adrian Chavez **Photo by Randy Montoya**

MIRaGE, a unique software created by Sandia under a Defense Advanced Research Projects Agency contract, uses knowledge developed from molecular spectroscopy that determines how the symmetry of a natural molecule affects its optical behavior and properties. This enables design of a metamaterial with comparable properties. By utilizing the user-friendly MIRaGE interface to specify properties, a designer might accomplish in minutes what might otherwise take months or years.

NEDs: High-Performance Nanoantenna-Enabled Detectors, principal investigator David Peters

Nanoantenna-Enabled Detectors offer a method to reduce noise interference to incoming infrared signals by factors of 10 to 100. Moreover, commercial long-wave infrared detectors only "see"

— CONTINUED ON PAGE 7

LABNEWS Notes

‘I do have a place’

Indian Energy Internship Program Q&A with Sherralyn Sneezer

Sherralyn Sneezer is one of four students who interned at Sandia this summer through the Indian Energy Internship Program. As we observe Native American Heritage Month this November, the Lab News spoke with Sherry about her experience at Sandia and her plans for the future. Sherry has a bachelor’s degree in environmental studies with honors from Dartmouth College, and is from the Navajo Nation.

What was the program like?

We went on several field visits to the Navajo Nation, the Laguna Pueblo and the Acoma Pueblo. We also visited the Mescalero Apache and the Picuris Pueblo, which were both beautiful places. The program allowed us to talk face-to-face with tribal professionals working in energy development, as well as learn about the relationship between utilities and tribal nations, especially regarding energy development on tribal lands.

Even though I’m from the Navajo Nation, I have not had the opportunity to talk with renewable energy specialists from the Navajo Tribal Utility Authority, and it was an important discussion that allowed me to glimpse into the present and future of renewable energy development on the Navajo Nation. I was able to critically think about what is needed to pursue further renewable energy development, so that I could better understand where I am needed in this pursuit.

There were four Indian Energy interns this year: two from the Navajo Nation, one from Acoma Pueblo and one from the Spirit Lake Band of Chippewa. Additionally, three other Native American interns in the Minority Serving Institutions Program tagged along on field visits with us. They were Brett Alberts, Isnala Nanjin RoanEagle and Roy Rafael. These guys were an integral part of our field visits and internship program at Sandia. It has been interesting to learn about each other’s cultures. Before this internship, I didn’t know much about the different pueblos even though I grew up in Arizona.

UTILITY-SCALE SOLAR — Interns from the Indian Energy Internship Program and Minority Serving Institutions Program visited the Picuris Pueblo’s utility-scale solar photovoltaic field. From left, Brett Alberts, Sherralyn Sneezer, Callie Singer, Veronique Arguello and Wesley Matingou.
Photo courtesy of Sherralyn Sneezer

However, we were all able to bond over our love for our tribal nations and renewable energy development to empower our tribal communities.

What was your project?

I created multiple maps to illustrate the potential locations for solar photovoltaic energy development at the utility scale on the Navajo Nation. These maps were based off previous studies done by the National Renewable Energy Laboratory, but I made them specifically for the Navajo Nation, as opposed to all tribal lands like NREL’s studies.

Since the Navajo Nation has different land issues, culturally sensitive areas and grazing permits, it has made it difficult to determine the best-suited sites for utility-scale solar energy development. Once I made the maps and determined the total area of the potential sites, I used the methodology from NREL’s previous studies to calculate the estimated energy capacity and generation if utility-scale solar PV fields were developed at each of these sites.

What was working with the mentors like?

The mentors are great, and they have been instrumental in the success of this internship program. Each mentor brought a unique aspect to the program through their different personalities and personal experiences, but they all made sure that the interns had all the tools needed to complete our research projects. Furthermore, they have been more than willing to assist us with our academic and career goals.

I’m applying to graduate schools right now, and the mentors have been very helpful in discussing how I can prepare, as well as what could help me accomplish my goals in the future, especially working with renewable energy on the Navajo Nation. It was truly a pleasure to get know the mentors and learn about the adversity they overcame to become successful at Sandia.

What is one of your main take-aways from this internship?

The biggest thing about this program was being able to talk with Sandia staff about their personal challenges and how they overcame those challenges. From their experiences, I found hope that I will also be able to overcome my challenges. I was under the impression that the journey from education to a career had to be a straight line in order to be successful, if that makes sense. I imagined life happening in a particular order: bachelor’s, master’s, doctorate, a successful career and then family. In my thought process, there was no time between those steps – just a continuous cycle without any breaks until all the stages had been completed. While I listened to my mentors, I realized that their journeys were not a straight line like I had imagined, yet they persisted.

It was good to hear about their personal experiences and journeys – it has been uplifting to me. There is sometimes a feeling that you don’t belong in a certain place, like at Dartmouth or Sandia. It’s a voice that says, “you’re not smart enough” or “you’re not an engineer” or “you only got in because you’re Native American.” We may hear it from other people, too, but we must persist. That voice does not build me up – only I can build myself up. I am passionate about helping my community, using renewable energy as a source to empower the Navajo Nation. I do have a place.

What would you like to do in the future?

For graduate school, I am very interested in the advanced energy systems master’s program at the Colorado School of Mines or the energy master’s at Texas A&M. My goal overall is to go back to the Navajo Nation and help with renewable energy development as a way to empower Navajo people. It’s been a very coal-dependent economy for the past 50 years, and one of the generating stations is closing at the end of this year. I’m interested in how to mitigate those effects on the Navajo Nation and people through the use of renewable energy.

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Albuquerque, New Mexico 87185-1468
Livermore, California 94550-0969
Tonopah, Nevada | Nevada National Security Site
Amarillo, Texas | Carlsbad, New Mexico | Washington, D.C.

Tim Deshler, Editor	505-844-2502
Angela Barr, Production	505-844-1388
Laura Hatfield, Production	505-845-0612
Randy Montoya, Photographer	505-844-5605
Paul Rhien, California Site Contact	925-294-6452

CONTRIBUTORS

Michelle Fleming (ads, milepost photos, 505-844-4902), **Neal Singer** (505-846-7078), **Stephanie Holinka** (505-284-9227), **Kristen Meub** (505-845-7215), **Michael Baker** (505-284-1085), **Troy Rummler** (505-284-1056), **Manette Fisher** (505-844-1742), **Valerie Alba** (505-284-7879), **Meagan Brace** (505-844-0499), **Melissae Fellet** (505-845-7478), **Luke Frank** (505-844-2020), **Michael Langley** (925-294-1482), **Darrick Hurst, team lead** (505-844-8009), **Jim Danneskiold, manager** (505-844-0587)

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LAB NEWS ONLINE: sandia.gov/LabNews

LABNEWS Notes

EDITOR’S NOTE: Lab News welcomes guest columnists who wish to tell their own “Sandia story” or offer their observations on life at the Labs or on science and technology in the news. If you have a column (500-800 words) or an idea to submit, contact Lab News editor Tim Deshler at tadeshl@sandia.gov.

GOOD SPORTS — Guys Give, a United Way of Central New Mexico affinity group, collected new and gently used sports equipment such as board games, sports equipment, and men’s and women’s athletic shoes, to benefit the Boys & Girls Clubs of Central New Mexico’s after-school program at Van Buren Middle School. The volunteers received a warm welcome when they delivered the donation to a group of enthusiastic program participants. **Photo by Katrina Wagner**

Defending the planet from the only preventable natural disaster

ILLUSTRATED ENTRY — Eric Stern, Entry Modeling Lead for NASA's Asteroid Threat Assessment Project, presents an illustration of an asteroid entering the Earth's atmosphere. **Photo by Lonnie Anderson**

By ***Melissae Fellet***

While significant asteroid impacts on Earth are rare, the ones that have landed have left a mark. There's the one that killed the dinosaurs, for starters. More recent impacts left craters in eastern Siberia and eastern Arizona. Videos immortalized on the Internet in February 2013 show a flaming meteor whizzing toward Chelyabinsk, Russia. The resulting explosion burst windows, damaged buildings and sent residents running for cover.

Since 1998, NASA has been mapping all the comets and asteroids within 30 million kilometers of Earth. As the map fills in, it's clear that this area is a very busy place.

"It's the luck of the draw we're not hit," said NASA Planetary Defense Officer Lindley Johnson. There are about 21,000 asteroids in the count so far, 900 of which are greater than 1 kilometer in size. That's only one-hundredth the size of the dinosaur-killing asteroid, but still large enough for an impact to have global effects. "This stuff is whizzing past all the time," Johnson said.

While no known large asteroid poses a significant risk of impacting the Earth in the next century, geologic evidence shows that the potential hazards from an impact cannot be ignored. Johnson leads NASA's Planetary Defense Coordination Office, which organizes national and international efforts to predict and mitigate hazards from an asteroid hitting the planet. The PDCO tracks the orbits of asteroids near Earth with ground- and space-based telescopes, works with international colleagues to craft emergency response plans and develops ways to deflect objects in space years before they're on an irreversible collision course with the planet (see sidebar).

While their mission seems straight out of a Star Trek episode, the office's daily work requires sophisticated engineering, modeling and detection, some of which directly involves Sandia expertise. Johnson, along with colleagues from NASA's Asteroid Threat Assessment Project, including Sandia researcher Randy Longenbaugh, spoke in Albuquerque in October about the challenges of defending the planet from an asteroid impact.

Asteroid entry

NASA's Near-Earth Object Observations program has identified almost all of the asteroids larger than 1 kilometer orbiting near Earth. This mapping has eliminated 96% of the risk of sudden, unexpected impact from an unknown large asteroid. Yet more than two-thirds of near-Earth asteroids 140 to 300 meters in size are still unmapped, Johnson said. These objects are at least 60 times larger than the meteor that hit near Chelyabinsk; an impact could generate a tsunami, a shock wave and a blast of heat.

To better understand what effects could be felt on the ground after an asteroid impact, ATAP, sponsored by the PDCO, is working to refine models of asteroid entry so they can extend those conditions to potential ground hazardous effects.

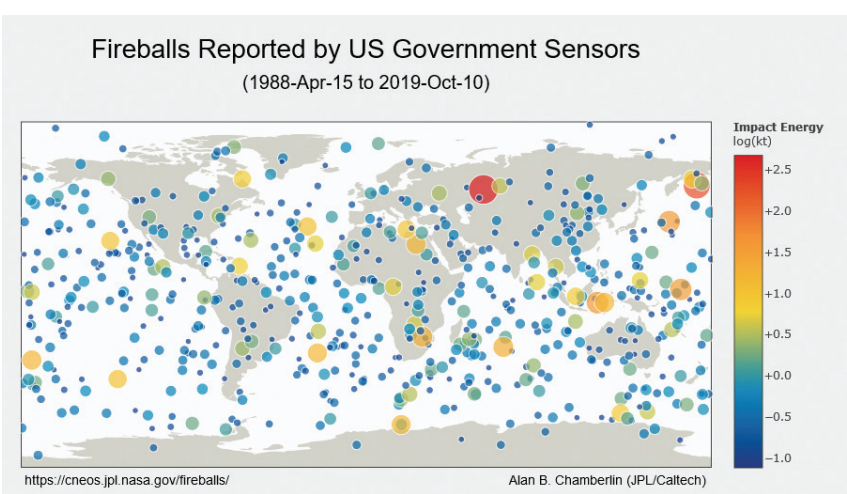
At first, asteroid entry seemed like a straightforward application for existing modeling of hypersonic spacecraft entry, said Eric Stern, ATAP entry modeling lead. "We quickly learned it's not as easy as you might hope."

The first difference is that the material that comprises asteroids melts during atmospheric entry, and unlike spacecraft, loses mass through the flow of liquid on the surface, Stern said. Also, much of the mass of an asteroid can vaporize during entry, and the vaporization products emit light that complicates interpretation of luminosity-based observations of an asteroid's speed and energy.

Very large uncertainties interpreting luminosity combined with sparse data from the few real-world impacts observed make it very difficult to validate predictions. But with a few tricks, existing tools can help.

Stern and his colleagues took a sample of a meteorite to NASA's Arc Jet Complex, an experimental test facility that generates an extremely hot atmosphere to test materials and develop models for spacecraft reentry. High-speed footage of material melting and vaporizing from the meteorite combined with infrared and spectral imaging of the vaporized meteorite components provided data that helped them refine their models of ablation and composition.

Another way to learn about the composition and entry of large asteroids is to track smaller ones that enter the atmosphere every few weeks as fireballs. For approximately 15 years at Sandia, Randy worked with Dick Spalding and Joe Chavez to detect fireballs, or bolides, using ground-based cameras and space-based sensors, including some developed at the Labs.



RAINING FIRE — This map of large meteors, or "fireballs," entering the Earth's atmosphere was created in part using data from Sandia sensors. The red dot in Russia is the very large meteor that hit near Chelyabinsk in February 2013. **Image by Alan B. Chamberlin (JPL/Caltech)**

"Observing bolides provides the best data to understand the composition of small asteroids and how they disintegrate in the atmosphere," Randy said. NASA uses data from sensors to record the disintegration of small asteroids when they hit Earth's atmosphere. A map produced from a limited amount of data from these impacts shows the impact locations marked with a dot proportional to the kinetic energy released during the impact. Combining various sensor data, this map is used to report geographic location, altitude of the disintegration, velocity and velocity components and the total radiated energy.

Randy is continuing his work on bolide detection while on temporary assignment at NASA Ames. As ATAP observational entry data lead, he is also working on real-time automated fireball detection, as well as bringing other types of Sandia sensing work to the project.

PLAYING DEFENSE — Lindley Johnson, Planetary Defense Officer at NASA's Planetary Defense Coordination Office, described how the group works to protect the planet from a potential asteroid impact. **Photo by Lonnie Anderson**

Temporary assignment

As a national laboratory and a Federally Funded Research and Development Center, Sandia is uniquely positioned to loan employees to federal agencies, congressional assignments or other partner institutions. Depending on the type of assignment, Sandians can temporarily act like federal employees or technical consultants; they can also perform a Sandia project at another institution.

After meeting Johnson and learning of the PDCO, Randy wondered if he might be able to do a sabbatical at NASA. At the same time, Johnson was interested in increasing PDCO's asteroid detection and characterization work.

Using the Intergovernmental Personnel Act, Randy has been able to work at NASA Ames for the past two years. He remains a Sandia employee, and is also granted temporary authority to act as an employee of NASA Ames for his three-year assignment. This is the first IPA Sandia has had with NASA in this type of work.

"It's been an incredible and very rewarding experience," Randy said. He has enjoyed working with colleagues based nationally at NASA and other federal agencies, as well as internationally. "It's also given me an opportunity to help a sponsor build a program, and I hope it creates new opportunities for Sandia too."

To learn more about offsite extended duty assignments, contact Sandia's Offsite Extended Duty Assignments Program office.

Double Asteroid Redirect Test

Currently, an asteroid impact is the only potentially preventable natural disaster. Lindley Johnson, planetary defense officer at NASA's Planetary Defense Coordination Office, described three options for changing the path of an incoming asteroid: slamming something into it to change its velocity (the kinetic impact option), dragging it off its path using a gravitational attraction (the gravity tractor) or detonating a nuclear device nearby to push an asteroid off its orbit (the nuclear option).

"The nuclear option may be the only choice if time is short or the object is very large, but there are obvious international treaty issues with that," Johnson said.

The PDCO is developing its first mission to test the kinetic impact option. Called the Double Asteroid Redirect Test, DART will launch in September 2021, headed toward the moon of an asteroid called Didymos. The craft will slam into the moon a year later, disrupting its orbit without altering the orbit of the entire asteroid system.

CA honors veterans at annual ceremony

Story and photos by ***Michael Langley***

Nearly 200 people gathered around the flagpole at the Sandia/California campus on Nov. 11 to honor and respect America's veterans.

The ceremony marking Veterans Day — originally Armistice Day, following World War I — was organized by the Military Support Committee and featured speakers Tim Shepodd, mission engineering sciences senior manager and CA-MSC executive champion, and David Colon, CA-MSC cochair; the Sandia/California Thundertones choir; and a U.S. Navy Sea Cadets Corps color guard from Camp Parks in Dublin, California.

"We want to honor everyone who came today," Tim said during his address. "They come from all walks of life, and they share the traits of courage, selflessness and dedication to duty."

About 10% of the overall Sandia workforce are veterans or active military members.

"Every day, Sandia directly supports warfighters around the world," Tim said. "Veterans at Sandia are not only part of our rich history, but they are making history today and every day — in support of Sandia's goal of exceptional service in the national interest. This great nation is stronger and safer because of the work we do here. Much of that is accomplished and enabled by our veteran workforce."

Rachel Sowell, CA-MSC cochair, talked about the Sandia/California Veterans Wall, which memorializes Sandians and their family members who served their nation in uniform.

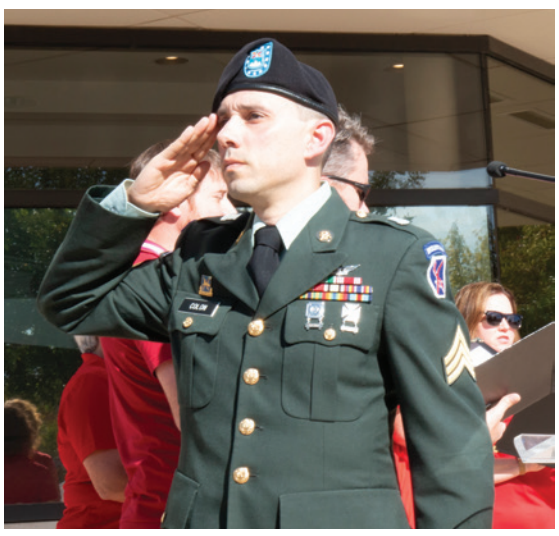
"For the last three years, the California MSC has made it a tradition to recognize and honor veteran employees and their family members by creating a 'Veterans Wall' that is proudly displayed the week before Veterans Day in the cafe lobby of Building 915," Rachel said. "With changes to the cafe lobby, we needed to create a new look for our annual Veterans Wall, and I think that we succeeded."

"Individual panels were put up in various buildings for people to see, and then all five panels were brought together for our Veterans Day event to create the wall." she said. "We will continue to recognize and honor our fellow Sandia veterans and their family members — not just during Veterans Day, but throughout the year."

The Sea Cadets presented the colors — flags from each military branch alongside the American flag — and the Thundertones sang the national anthem, followed by "My Country, 'Tis of Thee."

The Veterans Day program drew veterans of all ages and branches, as well as their families and others from Sandia wishing to honor them. Each veteran in attendance was given a challenge coin specifically made for the occasion. In addition, 50 veterans received a star from a flag that flew over Sandia/California before being respectfully retired. The stars can be carried to remind veterans that their service is appreciated.

If you would like to submit your photo and military information — or that of a family member — for the Sandia/California Veterans Wall, contact Rachel Sowell or Adina Eliassian.



Veterans honored at annual NM celebration

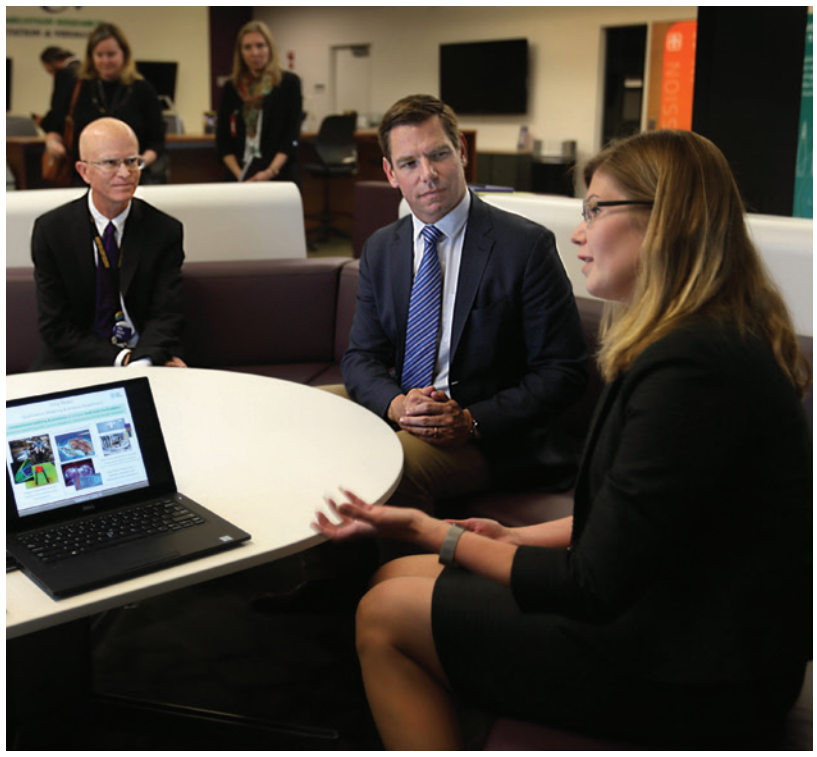
Story and photos by ***Randy Montoya***

Sandia celebrated the 100th anniversary of Veteran's Day in the Steve Schiff Auditorium on Nov. 7. President Woodrow Wilson first enacted the day honoring veterans one year after the Armistice ending World War One, designating it as a day, "filled with solemn pride in the heroism of those who died in the country's service and with gratitude for the victory, both because of the thing from which it has freed us and because of the opportunity it has given America."

Hundreds of Sandia veterans and their families were honored at the annual event, which included a presentation of commemorative coins to Sandia's veterans and active service members. One in 12 Sandians is a veteran. The guest speaker for this year's event was David "D.J." Johnson, Ret. Col. USAF and vice president of the Federal Solutions Business Enterprise for Honeywell International, Inc. An information fair held in the lobby before and after the ceremony featured organizations that support active service members, veterans and their families. All service members were recognized during the Sandia Singers' performance of service songs for each branch of the military.

Sandia parents group hosts school choice fair

CHOICES, CHOICES — The Discovering Education Choices Fair returned in October to the Steve Schiff Auditorium after a hiatus in 2018. Thirty Albuquerque-area schools, nominated by Sandia parents, stood up information booths to pitch school tours, summer programs and educational philosophies. New this year was the addition of a panel of Sandia staff who discussed their experiences choosing schools. This was also the first year the Sandia Parents Group sponsored the event, supported by Community Involvement. The Sandia Parents Group has posted a lunch-and-learn discussion about school choice at https://bit.ly/31YeGDU. **Photos by Lonnie Anderson**



MODELING AND SIMULATION — Sandia computational scientist Irina Tezaur, right, spoke to U.S. Rep. Eric Swalwell, center, and Sandia Associate Labs Director Andy McIlroy about her ongoing modeling and simulation work enabled by her PECASE award. **Photo by Dino Vournas**

Congressman Swalwell visits Sandia/California

By ***Paul Rhien***

Rep. Eric Swalwell, Calif. visited Sandia/California on Nov. 4, where he met with Andy McIlroy, associate labs director for Integrated Security Solutions, and received briefings on a variety of topics.

Andy updated the congressman on recent developments at the California site, with a focus on Sandia's nuclear deterrence program and its impacts on employment and facilities. They discussed Sandia's significant employment growth and how the Labs is approaching recruiting and retention.

Swalwell also was briefed on Sandia's emerging work in resilient energy systems (modernizing energy infrastructure to deal with storms, wildfires and cyberattacks and ensuring continuity of critical operations), the Labs' emerging work in genomic security and civilian cybersecurity programs.

After the briefing, Swalwell met with Sandia computational scientist Irina Tezaur, who spoke to the congressman about her ongoing modeling and simulation work, enabled by her Presidential Early Career Award for Scientists and Engineers. The congressman presented Irina with a congratulatory certificate and letter.

SANDIA CLASSIFIED ADS

NOTE: The classified ad deadline for the January 3, 2020, Lab News is noon, Monday, Dec. 16.

AD SUBMISSION GUIDELINES

AD SUBMISSION DEADLINE: Friday noon before the week of publication unless changed by holiday.

Questions to Michelle Fleming at 505-844-4902.

Submit by one of the following methods:

- **EMAIL:** Michelle Fleming (classads@sandia.gov)
- **FAX:** 505-844-0645
- **MAIL:** MS1468 (Dept. 3651)
- **INTERNAL WEB:** Click on the News Tab at the top of the Techweb homepage. At the bottom of the NewsCenter page, click the **"Submit a Classified Ad"** button and complete the form.

Due to space constraints, ads will be printed on a first-come, first-served basis.

MISCELLANEOUS

DENON AVR-X2300W, Klipsch: RF-7 II towers, RP-250S surround, KSW-12 sub, Paradigm center, like new, photos available. Watkins, 505-294-6808.

METAL BISTRO SET, beveled glass top, 4 matching stools, very good condition, photos available, $400 negotiable. Candelaria, 505-720-6527.

TEMA SOFA, beige, good condition, photos available, $95. Elmazi, 505-856-2197.

PLASTIC RX BOTTLES, clean, labels removed, various sizes, great for holding nuts, bolts & smaller items in a workshop. Lewis, 505-323-7268.

BOOKS ON MOVIES & THEIR HISTORY, 4, 1 TCM DVD catalog, call for photos, $15/all. Colgan, 505-344-3776.

PLANER, w/stand, Sears Craftsman, 12-1/2-in., works well, new set of knives installed, $100. Kettleborough, judykettleborough@hotmail.com.

SOFA, loveseat, coffee table, $300; Master Built smoker & wood chips, never used, $300. Baca, 505-453-4534.

LUMINARIAS, will assemble & deliver the week of Dec. 16, benefits New Mexico Suncats softball, $8/dz. Byers, 505-554-0884.

REFRIGERATOR, Kenmore, French door, w/bottom freezer, 25-cu. ft., ice/water in door, 6 yrs. old, excellent condition, $800. Schneider, 505-377-9943 or 505-881-3012.

YULE YARD SALE, holiday items, benefits History Team projects, First Methodist Church, 4th Street & Coal SW, Dec. 5-6, 9 a.m.-3 p.m., Dec. 8, 11:30 a.m.-1 p.m. Linton, tlinton51@aol.com.

HIGH CHAIRS, 2, Fisher Price, lightly used by visiting grandchildren, will deliver in city, photos available, $30 ea. Matter, matterjohn@aol.com.

SLEIGH BED, twin, mahogany, w/head/footboard, side rails, Gel-Pedic mattress & box spring, very good condition, $300. Fulcher, 505-610-2700.

SLIDING GLASS DOOR, vinyl, 78" x 72", excellent condition, $450; pre-hung basic steel entry door, 36" x 80", $75. Young, 505-506-8280, ask for James.

LIGHT HAND TRUCK, $6. Marchi, 505-265-6211.

'WAITRESS' TICKETS, 2, Popejoy, Dec. 14, 8 p.m., Orchestra level, row T, seats 203-204, $80 ea., will only sell as pair. Fisher, 801-589-8939.

TRANSPORTATION

'09 HONDA CRV EX, all power options, nonsmoker, 119,775 miles, accident free, good condition, $7,600. Scott, 505-249-7175.

'07 RAM 1500 SLT, regular cab, long bed, 4.7L V8, 4x4, new LT tires, 145K miles, clean, excellent condition, $8,200 OBO. Cook, 505-615-2326.

'16 JEEP WRANGLER RUBICON, 6-spd. manual, 3-1/2" lift, 35x12.5 MT tires, 18K miles, $34,000. Smith, 505-263-3544.

'52 WILLYS PICKUP TRUCK, <100 miles on rebuilt original 4-cyl., flathead engine, front disc brakes, school bus yellow, $11,000. Aura, 505-238-2920.

RECREATION

'09 HARLEY-DAVIDSON NIGHT ROD SPECIAL, 1250cc, ABS, factory security, extras, denim black, $6,950. Davis, chdavis001@gmail.com.

REAL ESTATE

2-BDR. MOBILE HOME, 2 baths, 840-sq. ft., new 2019, refrigerator, stove, heater, never lived in, $3,974 under cost, $40,000. Johnson, 505-750-2353.

WANTED

VOLUNTEERS, help rescued cats, Fabulous Felines charity, fabulousfelines.org. Stubblefield, 505-263-3468.

USED PIANO, for my children, contact me to negotiate. Pelletier, 505-228-8045.

ROOMMATE, dog friendly, for Jan. move-in, near Tramway & Comanche, $500+ utilities. Delgado, 505-917-7090.

AD RULES

1. Limit 18 words, including last name and home phone (web or email address counts as two or three words, depending on length).
2. Include organization and full name with ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. The same ad may not run more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce and retired Sandians only.
10. Housing listed for sale is available without regard to race, creed, color or national origin.
11. Work wanted ads are limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in poor taste.

R&D 100

CONTINUED FROM PAGE 1

around 25% of the thermal radiation that hits them. This value is improved by NEDs to well over 50%. Thus, the signal-to-noise ratio of a camera based on these detectors would gain two to three times on signal while simultaneously allowing much clearer pictures.

The technology incorporates a nanoantenna — a subwavelength metal pattern — on the top surface of the detector, which concentrates the light and lets it use a detector layer that is just a fraction of a micron. This distinguishes the method from the 5- to 10-micron thickness of traditional detectors, which creates more noise in recorded images and pixel-to-pixel crosstalk in focal plane arrays, causing image blurring. Sandia's work overcomes both these issues in a single device. While potentially useful across the spectrum, this architecture is particularly useful at infrared wavelengths, where current technology has run into a roadblock for noise reduction, quantum efficiency and crosstalk: all key metrics for infrared image quality.

Special Recognition: Green Tech

GOLD: SiC-based Monolithic Transistor-Rectifier Semiconductor Switch, principal investigator Stan Atcitty

Sandia, in collaboration with GeneSiC Semiconductor, has developed the industry's first commercially available silicon-carbide, transistor rectifier on a single chip. The monolithic transistor rectifier switch allows power-electronic systems to operate at a four-times-higher switching frequency, thus allowing designs for proportionally smaller magnetic components like inductors and transformers, which are often the bulkiest components of power-electronics hardware.

Other significant advantages include more efficient bidirectional performance, lower switching and conduction losses, reduced cooling requirements, ease of paralleling devices and cost benefits. The invention also reduces the total amount of silicon carbide used by up to 50%. In power conversion terms, higher switching frequency means smaller size and lower cost.

Widespread use of this novel SiC device might result in saving more than 20% of the world's electricity costs and 40% more energy savings. It could spur innovations in a wide range of electricity-using devices, including electric vehicles, battery chargers, industrial/medical power supplies, data centers, electric ships, transportation electrification, photovoltaic inverters, wind energy converters and other utility-scale power electronics systems, such as high-voltage, direct-current transmission and flexible alternating current transmission systems.

SILVER: Ducted Fuel Injection, principal investigator Charles Mueller

Sandia researchers showed that ducted fuel injection can curtail the soot emissions from a diesel engine by 50% to 100% depending on the engine's speed and power level.

DFI is a conceptually simple technology, can be constructed from low-cost materials and is conceivably retrofittable onto existing engines. Like a Bunsen burner, the technique premixes fuel and intake gas using a small cylindrical duct around each fuel spray inside the combustion chamber. The low soot emissions of DFI also enable the use of more cost-effective approaches to control nitrogen oxide emissions, solving a long-standing emissions challenge for diesel engines. This could lead to substantial reductions in the size, cost, complexity and efficiency penalties of diesel exhaust-gas aftertreatment systems.

Furthermore, while DFI is fully compatible with current diesel fuel, blending with oxygenated renewable fuels like biodiesel can enhance its soot-reduction performance by another order of magnitude, while simultaneously increasing sustainability.

Special Recognition: Market Disruptor – Products

BRONZE: Stable Nanocrystalline Metal Alloy Coatings with Ultra-Low Wear, principal investigator Nicolas Argibay

Noble metal coatings and thin films are used in a wide range of products, from cell phones to slip-rings on wind turbines and the Mars Rovers. The lifetimes of all these devices depends to a large degree on the ability of the coating material to resist wear.

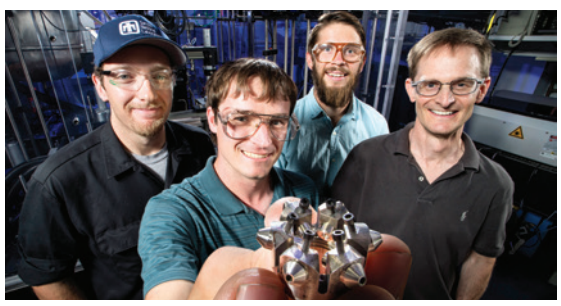
Sandia researchers have developed a platinum-based alloy that is extremely wear-resistant, using a technique called grain boundary segregation to create highly stable nanocrystallinity of a minority constituent — in this case, gold.

Compared with hard gold alloy coatings, platinum coatings demonstrate remarkably higher wear-resistance. This formerly unrealized mechanical performance is attributed to extraordinary thermodynamic stability of grain boundaries, which are more effective barriers to deformation. Platinum-gold coated electrical contacts demonstrate order-of-magnitude improvements in strength, thermal stability and wear resistance compared to hard gold alloy coatings and films.

Cloud Hypervisor-forensics and Incident Response Platform principal investigator Vincent Urias **Photo by Randy Montoya**

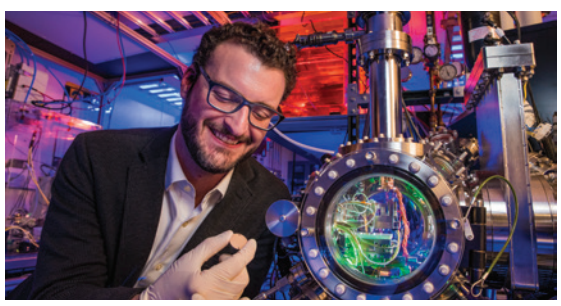
SiC-based Monolithic Transistor-Rectifier Semiconductor Switch principal investigator Stan Atcitty **Photo by Randy Montoya**

Multiscale Inverse Rapid Group-theory for Engineered-metamaterials team member Charles Reinke, left, and principal investigator Ihab El Kady **Photo by Randy Montoya**



Ducted Fuel Injection team, from left, Nathan Harry, Christopher Nilsen, Drummond Biles and principal investigator Charles Mueller **Photo by Randy Wong**

High-Performance Nanoantenna-Enabled Detectors team from left, Michael Goldflam, principal investigator David Peters and Anna Tauke-Pedretti **Photo courtesy of Sandia**



Stable Nanocrystalline Metal Alloy Coatings principal investigator Nicolas Argibay **Photo by Randy Montoya**

Phi-Sensitivity

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Facility, and former Sandia postdoctoral appointee Gerald Gentz.

"The paper identifies the fundamental chemical reactions responsible for phi-sensitivity," Dario said. "The paper examines how phi-sensitivity behaves when varying pressure, temperature, concentration of fuel and concentration of oxygen."

The paper also explores the potential of developing a fuel that has both high phi-sensitivity and a high octane-rating compared to the values for a regular-grade gasoline, which would make it an improved fuel for both LTGC and modern spark-ignition engines.

Importance of phi-sensitivity in LTGC engines

Phi-sensitivity has important benefits for the operation and control of LTGC engines. A fuel is phi-sensitive if its autoignition reactivity varies with the fuel/air equivalence ratio (phi).

"For an engine that works with a non-uniform air-fuel mixture, different regions of the combustion chamber will have different fuel/air equivalence ratios that will ignite at different times, leading to a sequential autoignition event that provides several benefits," Dario said. "Some of these benefits are extending the maximum allowable engine load, increasing the efficiency, easing the control of the combustion and improving combustion stability."

The first part of the paper describes the fundamentals of phi-sensitivity, identifying the chemical kinetics responsible for it and explaining how it behaves when varying the operating conditions.

"I like to think of phi-sensitivity like any other fuel property ¬— its value changes with the working conditions," Dario said. "Viscosity can be a good analogy. Is the wax of a candle viscous? It depends on the temperature. Cold wax is very viscous, but melted hot wax is not. It's the same with phi-sensitivity."

"Is gasoline phi-sensitive? It depends on the operating conditions," he said. "Phi-sensitivity is a chemistry-dependent property, so it depends not only on temperature, but also on pressure and mixture composition. When we say that a fuel is not phi-sensitive, it means that is not phi-sensitive under typical engine conditions."

The second part of the paper explores the potential of developing a fuel that has both high phi-sensitivity and high octane.

"Designing a custom gasoline-like fuel blend is like developing a new cooking recipe," Dario said. "You want to identify the perfect combination of ingredients (hydrocarbons) to obtain the optimum result. When you cook, you blend condiments and different ingredients with a combination of flavors to give you the desired results. Similarly, when we blend a fuel, we combine hydrocarbon classes to give a combination of properties that gives us the desired result."

Dario said this work can help other researchers define the adequate operating conditions to take advantage of the phi-sensitivity of a fuel.

"Now, we know how we should modify the working conditions of the engine to enhance the phi-sensitivity and, more importantly, we know why this works," he said.

The work will also help future research on fuel development. "We showed that a fuel can show both high phi-sensitivity and a high-octane number," Dario said. "Understanding the phi-sensitivity fundamentals is important to design new fuels that would be suitable for both LTGC and modern spark-ignition engines."

Dario said the research shows that it is possible to design a regulation-compliant, gasoline-like fuel blend that simultaneously increases the phi-sensitivity and the octane number, to make an improved fuel suitable for both LTGC and modern spark-ignition engines, something that many automotive researchers thought might not be possible prior to the team's work.

Sandia Gives California

Volunteers help Fertile GroundWorks support local foodbanks

*By **Michael Ellis Langley***
*Photos by **Dino Vournas***

More than two dozen Sandians rolled up their sleeves and dug into the earth one October weekend to provide food for families in need in Alameda County.

The annual Sandia Gives campaign launched Oct. 5 at Fertile GroundWorks in Livermore, as volunteers spent the morning gleaning 305 pounds of squash, weeding 240 square feet of garden beds and adding 1,200 pounds of compost to the soil to grow even more food — more than 3,500 beet plants.

"Fertile GroundWorks could not do what we do without wonderful volunteers like you," said Brenda Kusler, Fertile Groundworks executive director. "You all truly rock. Thank you for enabling us to teach, grow and give. You also prepped the site for our 2020 tomato cage pyramid while another team of Sandians prepared flats and planted seeds for 900 plants."

Encouraging family stability

Fertile GroundWorks teaches people to grow food themselves and gives some of the vegetables and fruit they grow to Livermore food pantries. Community relations specialist Kayla Norris said Fertile GroundWorks is a perfect example of the type of organization that Sandia wants to support through volunteering and family-stability grants.

Sandians presented Fertile GroundWorks with a $10,000 check at the event. This grant, which aligns with Sandia's community relations pillar of encouraging family stability, honors the organization's efforts to address issues of food insecurity and hunger in the Bay Area by facilitating the creation of community, school and employee gardens.

"Every year, Sandians donate their time, effort and money to give back to our communities," Kayla said. "If we can help Brenda and her group provide for others, that's an amazing feeling. We have many opportunities for workforce members to give back in ways that benefit organizations in Alameda and San Joaquin counties."